New low surface energy materials

Summary

This proposal is to develop new Fluorine-free low surface energy materials (LSEMs), made only from readily available Hydrocarbon feedstocks: these will bring important advantages, being biodegradable, environmentally acceptable and cheaper to mass produce as compared with current materials. Our vision is a step change in the generation of LSEMs, eliminating Fluorine through intelligent design of commercially viable and sustainable resources with low environmental impacts.

Currently, LSEMs are made from Fluorinated compounds, because they are unique in being both hydrophobic and oleophobic. However, Fluorocarbons have significant environmental risks owing to bio-persistence and bio-accumulation, and are also costly. The applications of LSEMs range from high volume products, like protective or anti-adhesion coatings for fabrics and metals (PTFE cookware), to high-end applications in photovoltaics, supercapacitors and Uranium enrichment.

The research will stimulate new thinking across the diverse sectors that rely on LSEMs, for example:

- design and generation of Fluorine-free products
- replacement of expensive and hazardous Fluorine
- rethinking the synthesis and applications of low surface energy products

LSEMs work because of the type and strength of intermolecular interactions between the constituent molecules; these in turn are governed by molecular structure. Our recent results have demonstrated that structural modification of Hydrocarbon chains using hyperbranched tails (so-called “hedgehog” molecules) gives rise to dramatic reductions surface energy, notably even in the absence of Fluorine. The team will design and synthesize new “hedgehog” molecules and evaluate the links between molecular architecture and surface energy. We will pool our multidisciplinary skills spanning conception, design and chemical synthesis, as well as measurement of physico-chemical properties: Eastoe (UK, colloids and interfaces), Sagisaka (Japan, hyperbranched chemistry) and Guittard (France, Fluorine chemistry and LSEMs).